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ABSTRACT

The article reviews the cognitive behavioral approaches to the training of intelligence in the mentally retarded. A proposed structure of intelligent behavior is presented that serves as the basis for classifying the intended foci of the various training programs. Selected training programs are reviewed in terms of this classification. The training programs described tend to concentrate on executive or metacomponential functions; on components of acquisition, retention, and transfer; or on components of performance in tasks requiring intelligent behavior. Consideration is given to the roles structural and motivational variables should serve in programs of training. Conclusions are drawn regarding the present and potential success of programs for training intellectual skills in the retarded. (Author/PHR)

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Cognitive-Behavioral Approaches to the Training of Intelligence in the Retarded

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Abstract

This article reviews cognitive-behavioral approaches to the training of intelligence in the retarded. A proposed structure of intelligent behavior is presented that serves as the basis for classifying the intended foci of the various training programs. Then selected training programs are reviewed in terms of this classification. The training programs tend to concentrate upon executive or metacomponential functions; on components of acquisition, retention, and transfer; or on components of performance in tasks requiring intelligent behavior. Consideration is also given to the roles structural and motivational variables should serve in programs of training. Finally, conclusions are drawn regarding the present and potential success of programs for training intellectual skills in the retarded.

Cognitive-Behavioral Approaches to the Training of Intelligence in the Retarded

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In recent years, educational programs for the training of intellectual skills have flourished (e.g., Chiba, 1978; Feuerstein, 1979, in press; Mann, 1979; Mittler, 1977; Whimbey, 1978; Whimbey & Lochhead, 1979; Wickelgren, 1974). The scope and diversity of the many programs that have been proposed could scarcely be captured in a weighty tome, much less in a brief review article. Even in restricting this article to cognitive-behavioral approaches to the training of intelligence in the retarded, I have found a diversity of programs that is little short of bewildering. It simply is not possible to do justice to them all in this brief survey. I have therefore attempted to constrain the task in a way that it is hoped will combine at least some depth with a sense of the breadth that exists in the field. I shall first present a pretheoretical framework for the structure of intelligent behavior, and then discuss one or two research programs that attempt to train or explain how to train aspects of performance that fall into one or more of the structural entities in the pretheoretical framework.

Before setting out on this task, it is necessary to clarify the basic terms that delimit the task. By "cognitive-behavioral approach" is meant a program of training and research that attempts to modify behavior by creating changes in individuals' intellectual or social cognitions. Excluded from consideration are approaches that are strictly or almost entirely behavioral (e.g., Farb, Cottrell, Montague, & Throne, 1977; Skinner, 1968; Throne, 1970), eschewing or downplaying the importance of cognitions; similarly excluded are approaches that are extremely cognitive (e.g., Wickelgren, 1974), which for the most part have not yet been brought

to bear upon retarded performance. By "training of intelligence," is meant intervention that has as its goal improvement in individuals' abilities to adapt to their environments, whatever these environments may be. Adaptation may take different forms in different environments, and it is the matching of one's cognitions and behaviors to the demands of the environment in which one finds oneself that we believe constitutes the essence of intelligence. Finally, by "retarded," is meant a condition characterizing individuals whose inability to adapt to their environments is of sufficient magnitude as to render coping with real-world demands problematical. I recognize the vagueness inherent in this definition, but we believe that this vagueness extends to the concept of retardation itself. Intelligence tests are the most pervasive single type of measurement for identifying retardation, but I believe that adequate assessment of retardation would also have to take into account measurements of social competence, real-world adjustment, effectance motivation, and real-world knowledge (see Zigler, 1971). Perhaps in combination, measurements such as these can begin to identify the constellation of behaviors characterizing individuals whose performance can be intelligently labeled "retarded."

A Proposed Structure of Intelligent Behavior

I propose that the psychological bases of intelligent behavior can be understood, in part, in terms of components of human information processing (see Sternberg, 1979a). A component is an elementary information process that operates upon internal representations of objects or symbols (Sternberg, 1977; see also Newell & Simon, 1972). The component may translate a sensory input into a conceptual representation, transform one conceptual representation into another, or translate a conceptual representation into a motor output.

Components are of five kinds, with each kind performing a different type of function (Sternberg, 1979a, 1979b). Metacomponents are higher-

order control processes that are used for planning how a problem should be solved, for making decisions regarding alternative courses of action during problem solving, and for assessing and reassessing the success of one's problem-solving performance. Examples of metacomponents are (a) selection of lower-order components, (b) selection of a strategy for combining lower-order components, (c) deciding upon whether to remain with the strategy originally selected or to switch to a different strategy, and (d) deciding upon a rate of work commensurate with an acceptable quality of performance.

Performance components are processes that are used in the execution of a problem-solving strategy. Examples of performance components are (a) encoding stimuli, i.e., storing attributes of the stimuli in working memory and retrieving from long-term memory information that might be relevant in interpreting the stimuli, (b) inferring relations between two or more stimuli, i.e., determining in what ways the stimuli are similar and different, (c) justifying as "best" a solution that is superior to any of the other alternatives available, but that is nonoptimal, and (d) responding to a problem situation.

Acquisition components are skills involved in learning new information; retention components are skills involved in remembering information that has been previously learned; transfer components are skills involved in carrying over previously-learned information from one situational context to another. We believe that the cues used to acquire, retain, and transfer information are highly overlapping. Examples of these kinds of components can be found in the utilization of (a) multiple presentations of a single piece of information in a given context, (b) multiple presentations of information in a variety of contexts, (c) surrounding context to understand the target information, and (d) previously learned information to understand the target information. These components store, maintain, and retrieve the information upon which performance components act.

The various kinds of components are closely interrelated, as would be expected in an integrated, intelligent system (Sternberg, 1979a). In the proposed system, only metacomponents can directly activate and receive feedback from each other kind of component. All control to and from the system passes directly from and to the metacomponents. The other kinds of components can activate and communicate with each other only through the metacomponents. For example, acquisition of information affects retention of information and various kinds of transformations (performances) upon that information, but only via the link of the three kinds of components to the controlling metacomponents.

Components also differ in levels of generality: Each of the functional kinds of components described earlier can be either general, i.e., common to a universe of tasks under consideration, class, i.e., common to a proper subset of tasks (numbering at least two) in the task universe, or specific, i.e., unique to a single task within the task universe. The level of generality of a given component will obviously depend upon just how broad the universe of tasks to be considered is: A general component in the universe of inductive reasoning tasks might be a class component in the universe of both inductive and deductive reasoning tasks.

Although the various kinds of components form the core of the proposed intelligent system, they are by no means the only sources of individual differences, either between the retarded and the normally functioning, or among retarded performers. First, components act upon different informational contents (e.g., verbal, numerical, geometric), and the informational content can be expected to influence the efficacy with which components function in different individuals (Sternberg, 1977). Second, information can be presented in a variety of modalities (e.g., visually, orally, kinesthetically), and the modality of presentation can be expected to influence the efficacy of information processing (Horn, 1974). Finally,

the processing of information will be affected by a host of motivational variables that can have a substantial effect upon performance (Zigler, 1971). Thus, the functioning of various kinds of components can be adequately understood only in the whole context in which they operate.

Some Programs of Training and Research

The pretheoretical framework presented in the preceding section suggests a number of possible loci that might be responsible for observed performance deficits in the retarded. Investigators have differed in the locus or loci upon which they have concentrated in their training efforts, and in their reasons for choosing various loci. We shall now consider some of the efforts that have been made to train intellectual skills in the retarded. In doing so, we shall consider the rationale for and perspective behind each training effort, the kinds of training that were employed, and the outcomes of the training. In assessing outcomes, we shall be concerned in particular with how durable or long-lasting the training proved to be, and with how generalizable or transferable the training proved to be.

Training of Metacomponents

For activation of acquisition, retention, and transfer components. Earl Butterfield and John Belmont have been conducting a program of training and research over the past twelve years with the aim of understanding and improving the metacomponential functioning of retarded individuals (Belmont & Butterfield, 1969, 1971a, 1971b; Butterfield & Belmont, 1971, 1977; Butterfield, Wambold, & Belmont, 1973). Their program has concentrated upon the role of metacomponential (or executive) functioning in acquisition, retention, and transfer processes. Underlying their research is the theoretical view that "competent cognition requires an active, deliberate, planful search for solutions to the information-processing problem at hand, and that retarded people do not so search" (Butterfield & Belmont, 1977, p. 279). The decision of these investigators to train performance

at the metacomponential (executive) level stemmed from two considerations, one positive, the other negative. The positive consideration, arguing in favor of training at the level of metacomponents, derived from the observation that

> retarded persons can perform all of the component processes required for excellent performance on one particular memory task....What they did lack was spontaneous access to the processes and coordination among them. If this failure of executive control is transsituational... then the appropriate level of analysis for future research is the level of selecting, sequencing, and coordinating processes that are in the cognitive repertoire. (Butterfield, Wambold, & Belmont, 1973, p. 668)

The negative consideration, arguing against training at the level of performance or acquisition components, derived from the further observation that

> if one is concerned with devising a remedial program to induce general cognitive competence in retarded persons, a research strategy like ours would require systematic analyses of one cognitive domain after another, over a tremendous diversity of domains, with applied experiments along the way to show how to improve each component skill....The conglomerate enterprise would...be enormous, and its immediate payoff unsure. (Butterfield, Wambold, & Belmont, 1973, p. 668)

A good example of a paradigm for training and research that is characteristic of Butterfield and Belmont is found in Belmont and Butterfield (1971a). In this study, these investigators sought to show that it was possible to reverse patterns of performance of normal and retarded individuals by facilitating a metacomponential function in retarded individuals and by impeding this function in normal individuals.

An oft-repeated observation in the memory literature is the serial-position curve, whereby items presented near the beginning and near the end of a list tend to be recalled better than items in the middle of the list. Superior recall of

the earlier items (the primacy effect) is usually attributed to the effects of long-term memory, whereas the superior recall of the later items (the recency effect) is usually attributed to the effects of short-term memory (Crowder, 1976). Several investigators have found that manipulating the rate at which items are presented has an effect upon recall of earlier items by normal subjects; specifically, faster presentation reduces recall of words near the beginning of the list (Glanzer & Cunitz, 1966). Glanzer and Cunitz suggested that slow presentation permits more rehearsal than does fast presentation, and that increased rehearsal of earlier items leads to higher recall of these items.

Retarded subjects do not show a reduction in primacy with faster presentation rates. This interaction between the performance of the normal and the retarded led Ellis (1970) to conclude that mentally retarded performers simply do not rehearse (or minimally rehearse) items, even under conditions of slow presentation. It seems unlikely that the deficit of the retarded is at the level of an acquisition component, i.e., that retarded performers are unable to rehearse. Presumably, almost anyone is capable of repeating presented words subvocally. Rather, it seems more likely that the deficit is at the level of a metacomponent: Retarded performers simply do not choose to rehearse. The acquisition component is never invoked in the first place.

These observations led Belmont and Butterfield to manipulate rehearsal in the normal and in the retarded. Subjects in their experiment were 30 normal and 30 retarded individuals. Subjects were presented with 36 six-letter lists, each consisting of a letter set containing no repetitions. Each letter was presented for a duration of ¼-second, although the duration of the interval between letters was paced by the subjects themselves. After seeing the last letter in a given list, the subject saw a probe letter, which was one of the letters from the list that had just been learned. The subject's task was to indicate in which position the probe

had occurred.

For the first 18 trials, subjects performed the task under free-strategy instructions, i.e., they performed the task in whatever manner they saw fit. For the next 18 trials, subjects were divided equally into three instructional groups. One group continued with the free-strategy instructions from the first 18 trials. A second group received passive-strategy instructions intended to preclude active rehearsal; subjects in this group were told to say each letter once aloud as it appeared and then to go directly to the next letter. The third group received active-strategy instructions intended to encourage rehearsal; subjects in this group were told the same thing as those in the passive group, except that they were also told to pause to rehearse the first four letters after the fourth letter had been presented to them.

During the first 18 trials, normal subjects showed a pattern of increasing pause times between successive letters, whereas retarded subjects showed a pattern of decreasing pause times. This statistically significant crossover interaction suggested that normal subjects rehearsed as they went through the list, pausing longer after each successive letter in order to accommodate an additional letter for rehearsal. The retarded subjects showed no evidence of rehearsal, however, actually speeding up over successive presentations of letters. The recall functions of the two groups reflected their strategies. Although there was no difference in recency (for the later-presented items whose recall is presumably unaffected by rehearsal), retarded subjects showed a greatly reduced primacy effect, presumably reflecting their failure to rehearse and thus to maximize recall of early-presented items.

During the second 18 trials, primacy performance depended upon the strategy condition to which subjects were assigned. Subjects continuing in the free-strategy condition showed the same patterns of performance as for the first 18 trials.

Retarded performers in the active-strategy condition showed superior recall to those in the other two conditions; normal performers in the passive-strategy instructional condition showed inferior recall to those in the other two conditions. No conclusions could be drawn regarding primacy differences between free-strategy and active-strategy normals, or between free-strategy and passive-strategy retardeds, due to ceiling and floor effects respectively.

Belmont and Butterfield (1971a) concluded from their results that the deficiency of retarded performers in recall of early items is due in large part to the failure of these performers to rehearse, and that this failure results from failure of the retarded performers to generate an appropriate strategy for learning the items. When the retarded subjects were taught to rehearse, significant gains in primacy recall (20 to 30 percentage points) were obtained. Missing from the experiment, however, is any indication of whether the induced changes in the retarded were durable or generalizable to other situational contexts. In the absence of these indications, final judgment on the success of the treatment must be reserved. The experiment does show, however, how rather simple metacomponential training can result in a substantial improvement in immediate performance in recall.

For activation of performance components. Reuven Feuerstein has also engaged in an extensive program of training and research dealing with metacomponential functioning, although the kinds of tasks he has studied have been quite different from those of Butterfield and Belmont. His primary concern has been with improving the reasoning performance of retarded individuals. Feuerstein (1979) has suggested a number of sources of deficit in the retarded, many of them metacomponential, e.g., inadequacy in the perception of the existence and definition of an actual problem, inability to select relevant vs. nonrelevant cues in defining a problem, lack of spontaneous comparative behavior or limitation of its application, lack of or impaired need for pursuing logical evidence, lack of or impaired strategies for

hypothesis testing, and lack of or impaired planning behavior.

Feuerstein's views on retardation find their roots in Vygotsky's notion of a zone of potential (or proximal) development (Vygotsky, 1978; see also Luria, 1961). In this notion, a

> distinction is made between a child's actual developmental level, i.e. his completed development as might be measured on a standardized test, and his level of potential development, the degree of competence he can achieve with aid. Both measures are seen as essential for the diagnosis of learning disabilities and the concomitant design of remedial programs. (Brown & French, 1979, p. 219)

Like Vygotsky, Feuerstein (1979) believes that "static measures completely neglect separate assessment of the dimension of modifiability because they equate the measure of manifest functioning with the true and immutable capacity of the individual....The dynamic approach...takes into consideration the possibility of modifying this repertoire by appropriate strategies of intervention" (p. 95).

Feuerstein has devoted a major portion of his research effort over the past decade to the development and testing of what he calls a Learning Potential Assessment Device (LPAD). He suggests that the dynamic psychometric evaluation provided by his LPAD goes beyond static psychometric evaluation in assessing the modifiability of the individual when he or she is confronted with conditions aimed at producing change, and in searching for preferential modalities and strategies that can result in the most efficient and economical form of cognitive and behavioral modification. In order to understand how the LPAD differs from conventional psychometric assessment devices, it is necessary to understand the testing procedures used and the kinds of abilities that are tested.

Feuerstein believes that the typical "culturally deprived" examinee enters ability testing situations with reduced motivation attributable to a lack of curi-

osity about the situation, a lack of a need system that would endow the tasks to be performed with a specific personal meaning, and an avoidance reaction to the kinds of tasks that have been associated with repeated experiences of failure in the past.

> The presence of a neutral, even sympathetic, and yet basically unresponsive examiner who limits his interaction with the examinee to issuing dry, standardized instructions, cannot but add a further negative valence to the test situation. The examinee's very fragmentary grasp of the instructions and his lack of motivation toward the task will lead either to a correspondingly vague or imprecise way of dealing with the problem at hand, accompanied by a low level of anxiety and a tuning-out of the examiner, or, to the contrary, to a high level of anxiety, involving a feeling of great threat and low expectations of success. (Feuerstein, 1979, p. 101)

Feuerstein's testing procedure is in many respects the diametric opposite of the typical psychometric testing procedure.

> The examiner constantly intervenes, makes remarks, requires and gives explanations whenever and wherever they are necessary, asks for repetition, sums up experiences, anticipates difficulties and warns the child about them, and creates reflective insightful thinking in the child not only concerning the task but also regarding the examinee's reactions to it....He is vibrant, active, and concerned instead of aloof, distant, and neutral, and gives the examinee the feeling that the task is important, difficult, and yet quite manageable. (Feuerstein, 1979, p. 102)

The subtests that constitute the LPAD seem to be of the kind used to measure "fluid ability" (see Cattell, 1971; Horn, 1968). The emphasis is upon the processes of thinking and learning new skills (e.g., matrix problems, analogies, pattern learning), rather than upon the products of thinking and learning (e.g., vocabulary, general information, special knowledge) that are assessed by tests

of crystallized ability. In figural and verbal analogies, for example, the individual must figure out which of several terms is related to a third term of an analogy in the same way that the second term is related to the first term. In the verbal items, vocabulary was kept at a low level so that the difficulty of the items would be in the need for reasoning rather than in the need for vocabulary.

Feuerstein (1979) has used several types of "mediated" (or metacomponential) trai ing to produce "mediated learning" (or learning how to learn). One exercise, intended to develop systematic classificatory behavior, teaches children how to identify categorizing criteria and how to ascertain the suitability of a certain term for membership in a specific category. For example, students in a classroom might be asked what a "couch" is. Typical responses from the children would be that it is "furniture," "something to sit on," and "something to lie on." The children would then be asked which of several other items has differing numbers of these properties. In a second exercise, intended to develop systematic exploration, discrimination, and summative behavior, individuals must find items that belong to a prespecified category count the items, find the sum for each of several rows, and find the total sum over all of the rows. In a third exercise, children are presented with pairs of words, and are asked to find the similarities and differences between them on some dimension. For example, "hammer" and "needle" are similar in that they are both tools, but different in that the former is a carpenter's tool whereas the latter is a tailor's to

In an experiment involving 551 children (including urban, upper-middle class school children; urban, lower-class school children; and educable mentally retarded school-children), Feuerstein (1979) found significant improvement in LPAD analogy scor as a result of both verbal and figural mediated training. Results were not reported by group, however, so that it is not possible to compare the improvement, say, of retarded versus upper-middle class children. Unfortunately, long-term durability and transfer of training were not investigated in this study. Some immediate

transfer was found, however, in that verbal training seemed to improve figural performance substantially, and figural training seemed to help verbal performance slightly.

Training of Acquisition, Retention, and Transfer Components

Ann Brown and Joseph Campione have been two of the leading investigators in the training of acquisition, retention, and transfer components in the retarded (e.g., Brown, 1973, 1974, 1975, 1978; Brown & Campione, 1977; Campione & Brown, 1974, 1977). Although many of their experiments are highly similar to those of Buttefield and Belmont, the theoretical motivation that has led to their experiments has been slightly different from that of Butterfield and Belmont. Brown (1974), for example, has stated that

> if, as suspected, lack of a general intention to use strategies (and the capacity to invent them) is a structural limitation of the immature memorizer, we should find that attempts to induce this general motivational set would be doomed to failure....Thus, it is the author's opinion that the crucial step needed at this point in time is convincing evidence of the establishment of a trained strategy which will show at least some breadth of transfer or generalization. (p. 103)

Brown is thus more willing to train subjects at the level of acquisition, retention, and transfer components and the strategies into which they combine than are Butterfield and Belmont. The distinction between the two groups of investigators appears to be more one of emphasis than of basic principles, however. Campione and Brown (1977) make clear that "(1) training specific skills will not result in real remediation in effects and (2) more general factors must underlie both the lack of spontaneous use of strategies and the failure to show generalization of training" (p. 382). Moreover, Brown has conducted an extensive program of research on metamemory (knowledge of and control over

one's memory processes). Metamemory would seem necessarily to involve metacomponential functioning (see Brown, 1978; Brown & DeLoache, 1978).

Brown (1974) has outlined a series of steps that seem to be required in order to plan successful cognitive-behavioral training interventions for the retarded (pp. 101-102):

1. The investigator must analyze any specific task into its component strategy and capacity requirements.

2. The investigator must test for the spontaneous use of the necessary strategies for performing the task, and if they are absent or deficient, deliberately train retardates in their effective use, either in the laboratory or in a school setting.

3. The investigator must determine whether retardates can maintain the acquired strategy over time.

4. The investigator must demonstrate that retardates show transfer of the strategy to a variety of tasks.

5. The investigator should devise techniques to train retarded children to monitor their own strategy production and to evaluate realistically the interaction between the task demands and their own capacity and repertoire of skills.

6. The investigator must take into account and alleviate retarded children's seeming lower motivation to learn. On the one hand, it is possible that once a strategic repertoire of skills is acquired, motivation will increase of its own accord. On the other hand, there is no assurance that motivation will increase in this way, and it may be necessary to train motivation as well as cognition (cf. Zigler, 1971).

At this point in time, Brown believes we are, at best, at the fourth step:

> So far, the prognosis for training a generalized skill in retarded children is not optimistic as there is little evidence in the litera-

> ture to date of generalization of an acquired strategy. Indeed, both American and Soviet investigators have suggested that one of the main difficulties in training mildly retarded children is that they tend to acquire information which is "welded" to the form in which it was acquired (Shif, 1969, p. 347), thus depriving them of an indispensable flexibility. (Brown, 1974, p. 102)

Not everyone is as pessimistic as Brown and Campione regarding the generalizability of strategy training. Another leading investigator in the field of mental retardation, John Borkowski, has contended that "given optimal training, acquired skills and strategic behaviors of retarded persons are persistent and generalizable" (Borkowski & Cavanaugh, 1979, p. 569). According to Borkowski, the most important factors in strategy maintenance are the amount and appropriateness of strategy training (Borkowski & Wanschura, 1974; Wanschura & Borkowski, 1975). Borkowski and Cavanaugh (1979) have pointed out that although many investigators have provided more than one training session, they have not directly manipulated the extent of training, and hence have not been able to draw conclusions about the effects of extent of training on strategy maintenance. These authors have made several suggestions, culled from the literature on cognitive behavior modification, that they believe can lead to successful generalization of trained strategies by retarded subjects:

1. The behavior should be trained so that at transfer it is maintained by natural contingencies in the new environment (Stokes & Baer, 1977).

2. Training should occur across a large number of settings and should be conducted by several persons (Stokes & Baer, 1977).

3. Stimuli present in the test setting should also be present in the training setting.

4. Generalization behavior should be reinforced (Goetz & Baer, 1973).

5. If the training context is free of many of the sources of distraction that

are present in the generalization context (e.g., a classroom), then "innoculation procedures" should be introduced during training (Meichenbaum, 1977), such that the child learns how to turn attention away from the distracting events; for example, the distractions might be systematically introduced into the training environment so that the retarded individuals learn slowly to cope with them. The latter procedure seems to be preferable, in that real-world performance is inevitably beset by distractions.

Borkowski and Cavanaugh (1979) have suggested that several studies that have incorporated at least some of these elements have demonstrated successful generalization of skills (Kahn, 1977) or strategies (Belmont & Borkowski, 1978). Both studies used detailed, extensive training, which appears to be a prerequisite for generalization of training effects.

Training of Performance Components

Training of performance components, or "process training," has been widespread during recent years, perhaps, as Kane and O'Brien (1954) have claimed, because a resurgence in process training occurs during "periods when some particular dominating curriculum in the schools has fallen into a rut of staleness and dead routine" (p. 196). Mann (1979) has suggested the nature of the rut that led to the current spurt of process training in special education:

> The younger generation in this field finds itself inundated with curricula, technologies, and assessment devices undigestible in their numbers and claims. It was not so, not so many years ago, when the making of potholders and popsicle-stick bird nests constituted much of curriculum within many of our special education classes, classes that were special largely in the experience of segregation they offered. There was very little that special education could show in these antediluvian years to justify its existence as an instructional vehicle for the cognitively handicapped. Special education was maintenance education; much of its achievement lay in the fact that mentally handicapped children were

> being educated at all....And so the appearance of process training... was, to special education, rain upon parched land reviving enthusiasm, restoring hope, galvanizing programs of intervention. (p. 538)

A number of successful training interventions have been devised at the level of performance components (see Mann, 1979). Reuven Feuerstein has devised several such interventions intended to improve reasoning performance. When these are administered in conjunction with interventions at the metacomponential level (such as those described earlier), the interventions at the level of performance components precede the interventions at the level of metacomponents. Consider an example of process training Feuerstein (1979) has used for the solution of verbal analogies of the kind that play a crucial role in several theories of intelligence (see Spearman, 1923; Sternberg, 1977; Whitely & Barnes, 1979).

The teacher points out to members of a class the first term of an analogy, say, HUT, and then points out the second term, say, HOUSE. The students are asked to generate a sentence that connects the two words, but that also shows the difference between them, say, THE HUT IS SMALL BUT THE HOUSE IS BIG. The students are thereby shown that if they ask themselves, "WHAT IS BIGGER THAN THE HUT?" the answer is "THE HOUSE." Members of the class are next shown the third term of the analogy, say, BUSH. They are then told to look for the analogy: "We have the word 'bush,' and we ask the same question we asked above. What is bigger than a bush? The correct answer is number 4, a tree" (where the options are 1. TOWN, 2. FOREST, 3. SEEDLING, 4. TREE, 5. FENCE, 6. BRANCH) (p. 368). This procedure is repeated for large numbers of verbal analogies until, one hopes, the children have internalized the procedure and are able to perform it naturally and without prompting. Feuerstein used a similar procedure for figural analogies, helping students learn to decompose each figure into its parts, and then to find relations between these parts.

In the study described earlier (Feuerstein, 1979), this kind of process training improved analogy performance on the LPAD. Feuerstein found, however, that the most successful training intervention was a combination of training of both performance components and metacomponents.

Variables Affecting Training of the Various Kinds of Components

Our theoretical biases have led us to concentrate upon and organize this literature review around the various kinds of component processes that are, to greater or lesser extent, trainable. It is important also, however, to take into account at least some of the major variables that influence information processing. Indeed, we suspect that some of the failures that have been encountered in trying to ensure generalization of training may have derived from insufficient attention to these other kinds of variables.

Structural Properties of the Organism

In earlier times, a major source of disagreement among theorists of mental retardation was over whether the locus of retardation is in cognitive structures or in cognitive processes. The debate seems to have subsided somewhat, perhaps because structure and process are so interactive that theorists have realized that both must be taken into account in any theory of performance, whether in the retarded or in the normal. Differences in emphasis continue, however. The theorists whose work we have reviewed earlier have been among those emphasizing the importance of process distinctions. David Zeaman has been among those theorists who have emphasized structural distinctions (see, e.g., Fisher & Zeaman, 1970, 1973; House & Zeaman, 1963; Zeaman, 1978; Zeaman & House, 1963). Fisher and Zeaman (1973) have argued the point forcefully:

> Atkinson and Shiffrin (1969) have distinguished two general types of theoretical parameters, those representing fixed untrainable capacities of the subject (structural features), and those which are adjustable by experiential factors (control processes). The distinction is of singular importance for any research program which seeks to discover the relation of intelligence to processes such as learning, memory, and attention. If intelligence is viewed as a stable trait, for which there is ample evidence in our retardate population (Fisher

> & Zeaman, 1970), then we should look for parameters reflecting structural features rather than control processes to relate to intelligence. (p. 244)

Their conclusion, ultimately, is that control processes "are not regarded as likely candidates for relation to fixed components of intelligence, hence to retardation" (p. 173). In his earlier work, Norman Ellis (1963) also emphasized structural limitations among the retarded, hypothesizing that retardates' inferior performance on certain tasks could be attributed in part to attenuation in the amplitude and duration of the stimulus trace in short-term memory.

The structure versus process issue seems to be less salient today. First, as mentioned earlier, it is very difficult to talk about structure independent of process, or process independent of structure. Processes operate upon structures, and effects of structures can be manifested only through processes. It is not clear their effects are wholly or even largely separable. Second, the view of structure as responsible for mental retardation is in many respects self-defeating, since as Fisher and Zeaman point out in the passage cited above, structural variables are not trainable. But we know from studies such as those cited earlier that training of intellectual skills in the retarded is possible. One could argue that structural variables are only partly responsible for retardation, and that we should call "structural" those aspects of retarded performance that do not seem susceptible to modification. But as Campione and Brown (1977) have pointed out, "in principle, the inference that a structural feature is responsible for performance differences is possible only when all possible training procedures have been tried without success. Obviously, such a state of affairs will never be obtained" (pp. 369-370). Finally, at least some structural theorists have switched or at least broadened their allegiance: Ellis (1970), for example, has suggested that rehearsal processes play a major part in distinguishing retarded from normal

performance. Indeed, the Belmont-Butterfield (1971a) experiment described earlier was based upon a modification of an experimental paradigm originally introduced by Ellis (Ellis, 1970; Ellis & Hope, 1968).[1]

Motivational Properties of the Organism

Edward Zigler has championed the view that mental retardation must be understood as a "developmental" rather than as a "difference" phenomenon: The retarded are distinguished from the normal primarily in terms of their slower rate of and lower asymptote in intellectual development. The retarded thus differ in developmental level, but not in kind, from the normal (Zigler, 1967a, 1967b, 1967c, 1968a, 1968b; Zigler & Balla, 1979). This position has led Zigler to stress motivational factors in social development that lead retarded individuals to perform at a level below their intellectual potential. Mentally retarded individuals have life histories very different from those of normal individuals, and the social influences that they have experienced are in part responsible for their reduced level of functioning (Zigler, 1971).

Zigler's position seems to have been misinterpreted by some authors to be a "motivational" theory of mental retardation. Zigler (1969) has made it clear, however, that if there is a motivational theory of mental retardation, it is not his own: "Let me unequivocally declare that I have never advanced a motivational theory of mental retardation. I have been specific in asserting that the essential problem in mental retardation is an intellectual or cognitive one" (p. 536). Zigler has been equally emphatic, however, in his rejection of the view that mental retardation can be understood exclusively as a cognitive phenomenon:

> With the exception of my more radically empirical friends in the behavior modification area who would argue against both this cognitive emphasis and the need for a human typology which includes individuals

> of retarded, normal, and superior intellect, many thinkers would agree that it is only through reference to differences in the development and final level of formal cognitive functioning that the distinction between the intellectually retarded and the nonretarded can be reliably and consistently drawn.
>
> Now that we have constructed a reasonable and, in my opinion, valid frame of reference concerning the essential differences between the intellectually retarded and the nonretarded, it becomes my task to convince you that overemphasizing this basically sound position has resulted, at best, in incomplete and, at worst, totally erroneous explanations as to why, in prescribed situations, the retarded behave as they do....What must be grasped is that the behavior of the retarded, as for all human beings, reflects more than the formal cognitive processes that we have been discussing up to this point. (p. 49)

Just what kinds of additional factors need to be taken into account in understanding the behavior of the retarded? Zigler (1971) has suggested a number of factors, including atypically high motivation for social reinforcement arising from social deprivation; a negative reaction tendency arising from social deprivation, whereby the retarded child exhibits a reluctance and wariness in his or her interactions with adults; a less adaptive hierarchy of reinforcers; reduced expectancy of success; increased outer-directedness; and the effects of institutionalization.

Zigler's suggestions regarding sources of performance deficits in retarded individuals lead to a program of training and research that is different from, but complementary to, training and research of the kinds discussed earlier. In addition to training cognitive performance directly, investigators consider ways in which the motivational sets of retarded children might be modified so as to produce motivational sets that are maximally conducive to optimal task performance. Achenbach and Zigler (1968) fortuitously discovered how effective such training can be. They designed a series of studies to test the hypothesis that retarded

individuals are more outer-directed than normal individuals. The findings of the studies generally were consistent with the hypothesis. In one experiment, the experimenters' failure and success manipulations did not significantly influence children's behavior. During this experiment, however, the experimenters discovered a teacher of a class of 16 retarded children whose teaching methods manipulated precisely those variables that the experimenters believed to mediate outer-directedness. The teacher first showered new pupils with success experiences and with praise intended to increase these pupils' self-esteem. Thereafter, he specifically reinforced what he called "figuring things out for yourself." Independent thought was more highly rewarded than was correct responding. When the experimenters examined the performance of the 16 retarded children in this teacher's class on their task, they discovered that the children relied on external cues significantly less than did other retarded children, and even less (although not significantly so) than did children of normal intellect. This serendipitous finding suggested that it is not retardation per se that produces outer-directedness, but rather the particular set of experiences to which retarded individuals are subjected. Moreover, it suggested that outer-directed behavior can be modified with appropriate training methods.

Conclusions

It has not been possible in the span of this brief article to review any more than a smattering of the many programs of training and research that have been devoted to understanding and improving the intellectual performance of the retarded. But our selective review suggests that training of intelligence in the retarded is possible, but is probably generalizable only if a very broad view is taken of what constitutes intelligence and intelligent performance. When we review the training attempts that have been made in the context of the entire range of programs for research into the nature of mental retardation, we cannot help but

conclude that many of the failures to obtain generalization that have been reported are due in large part to the excessively narrow view of training that single programs of training and research have taken. In fairness to these researchers, it must be pointed out that one needs to start somewhere, and the various starting points that have been described in this article have been theoretically motivated and empirically feasible. But attempts to intervene in any one particular aspect of the functioning cognitive system are probably ultimately doomed to failure because of the rich and complex interactions that take place between the various functioning subsystems (of metacomponents, performance components, acquisition components, etc.). The various kinds of components are highly interactive (Sternberg, 1979a), and interventions that fail to take these interactions into account may simply be unable to effect permanent change. Indeed, if training is to be directed anywhere, it should probably be directed toward the interplay of the various subsystems. Unfortunately, our current understanding of this interplay is minimal. Again, in fairness to the investigators involved, it should be pointed out that many investigators have tried to understand and take this interplay into account in designing their interventions. As our understanding increases, perhaps the success of our interventions will as well.

Even taking into account the multifarious sources of interactions in cognitive subsystems is probably insufficient to design an optimal program of training for the retarded, because it appears that motivational factors exert powerful influences upon these subsystems, <u>especially</u> in the retarded. Without interventions designed to modify maladaptive motivational sets as well as inadequate cognitive functioning, it seems likely that the same motivational factors that led to depressed cognitive performance in the first place will eventually reassert themselves, leading once again to depressed performance of the modified cognitive repertoire.

The various theories of mental retardation, with their associated implications for training, seem for the most part to be complementary rather than contradictory. The interactions of various cognitive and motivational subsystems seem likely to lead to widespread loci of differences in the performance of retarded and normal individuals, and hence we might view a large subset of the extant theories as differing in emphasis rather than in kind. The one clear exception to this complementarity is the "immutable structural differences" theory, according to which the depressed performance of the retarded is to be understood in terms of immutable differences in cognitive structure between retarded and normal individuals. The evidence in support of this position is tenuous at best. In an unfortunate sense, moreover, the theory is not disconfirmable, in that it can always label as an "immutable structural difference" the source of any behaviors that seem not to be modifiable, whatever these particular behaviors happen to be at a given time. It is essential to distinguish this rather pessimistic view from a view that posits mutable structural differences between the normal and the retarded: Almost any current theory of cognition would hold that processes act upon and modify cognitive structure at the same time that structure in some sense circumscribes the possible processes that can be executed. In a Piagetian sense, new information that cannot be assimilated can often be accommodated, and when accommodation occurs, so does change in cognitive structure.

It may well eventually transpire that certain differences between aspects of the performance of the retarded and the normal just do not seem to be susceptible to reduction. In such cases, the goal of training research would seem to be to find teaching and learning situations that maximize the adaptive potential of these seemingly immutable aspects of performance. Turnure and Zigler (1964), for example, found that outer-directedness may be either detrimental or beneficial,

depending upon the nature of the situation. The search for aptitude-treatment interactions has not been an especially successful one, although it has been suggested that this is because the search has been, in many respects, inadequate both theoretically and methodologically (Cronbach & Snow, 1977; Sternberg & Weil, in press).

If any shift in research emphasis is needed at this time, it is toward greater concern with the durability and generalizability of training procedures. I suspect that the most durable and generalizable training will be that which intervenes at multiple levels of information processing, and which takes into account the interactions between them. Consider, for example, training of metacomponents and performance components and the interactions between them. Children might be taught how to (a) plan a strategy and monitor it as it is being executed, (b) translate the plan into action, and (c) actually execute the strategy. Training programs such as Feuerstein's and Belmont and Butterfield's seem like a step in this direction. Ideally, motivational interventions would be conducted in conjunction with cognitive ones.

Concentration upon long-term benefits will probably reduce the number of studies that any one investigator can conduct, but it will also tend more sharply to pinpoint those kinds of training that are likely to prove profitable in the long run. Without knowledge about durability and transfer, future generations of investigators may be led to pursue training methods whose short-term benefits are not matched by even the smallest long-term gains. With the new techniques that have been and are still becoming available for understanding and training intelligence in the retarded, it seems likely that we can find at least some training programs with lasting benefits. The appropriate message at the present time seems to be one of optimism and hope.

References

Achenbach, T., & Zigler, E. Cue-learning and problem-learning strategies in normal and retarded children. Child Development, 1968, 39, 827-848.

Atkinson, R. C., & Shiffrin, R. M. Human memory, a proposed system and its control processes. In K. W. Spence & J. T. Spence (Eds.), The psychology of learning and motivation: Advances in research and theory (Vol. 2). New York: Academic Press, 1969.

Belmont, J. M., & Borkowski, J. G. Instructing retarded children on two examples of a memory method (vs. only one) improves maintenance and generalization of that method. Paper presented at the Eleventh Annual Gatlinburg Conference on Research in Mental Retardation, Gatlinburg, Tenn., March, 1978.

Belmont, J. M., & Butterfield, E. C. The relations of short-term memory to development and intelligence. In L. C. Lipsitt and H. W. Reese (Eds.), Advances in child development and behavior. New York: Academic Press, 1969.

Belmont, J. M., & Butterfield, E. C. Learning strategies as determinants of memory deficiencies. Cognitive Psychology, 1971, 2, 411-420. (a)

Belmont, J. M., & Butterfield, E. C. What the development of short-term memory is. Human Development, 1971, 14, 236-248. (b)

Borkowski, J. G., & Cavanaugh, J. C. Maintenance and generalization of skills and strategies by the retarded. In N. R. Ellis (Ed.), Handbook of mental deficiency (Second Edition). Hillsdale, N.J.: Erlbaum, 1979.

Borkowski, J. G., & Wanschura, P. B. Mediational processes in the retarded. In N. R. Ellis (Ed.), International review of research in mental retardation (Vol. 7). New York: Academic Press, 1974.

Brown, A. L. Mnemonic elaboration and recency judgments in children. Cognitive Psychology, 1973, 5, 233-248.

Brown, A. L. The role of strategic behavior in retardate memory. In N. R. Ellis (Ed.), International review of research in mental retardation (Vol. 1). New York: Academic Press, 1974.

Brown, A. L. The development of memory: Knowing, knowing about knowing, and knowing how to know. In H. W. Reese (Ed.), Advances in child development (Vol. 10). New York: Academic Press, 1975.

Brown, A. L. Knowing when, where, and how to remember: A problem of metacognition. In R. Glaser (Ed.), Advances in instructional psychology (Vol. 1). Hillsdale, N.J.: Erlbaum, 1978.

Brown, A. L., & Campione, J. C. Training strategic study time apportionment in educable retarded children. Intelligence, 1977, 1, 94-107.

Brown, A. L., & DeLoache, J. S. Skills, plans and self-regulation. In R. Siegler (Ed.), Children's thinking: What develops? Hillsdale, N.J.: Erlbaum, 1978.

Brown, A. L., & French, L. A. The zone of potential development: Implications for intelligence testing in the year 2000. In R. J. Sternberg & D. K. Detterman (Ed), Human intelligence: Perspectives on its theory and measurement. Norwood, N.J.: Ablex, 1979.

Butterfield, E. C., & Belmont, J. M. Relations of storage and retrieval strategies as short-term memory processes. Journal of Experimental Psychology, 1971, 39, 319-328.

Butterfield, E. C., & Belmont, J. M. Assessing and improving the executive cognitive functions of mentally retarded people. In I. Bialer & M. Sternlicht (Eds.), Psychological issues in mental retardation. New York: Psychological Dimensions, 1977.

Butterfield, E. C., Wambold, C., & Belmont, J. M. On the theory and practice of improving short-term memory. American Journal of Mental Deficiency, 1973, 77, 654-669.

Campione, J. C., & Brown, A. L. The effects of contextual changes and degree of component mastery on transfer of training. In H. W. Reese (Ed.), Advances in child development and behavior (Vol. 9). New York: Academic Press, 1974.

Campione, J. C., & Brown, A. L. Memory and metamemory development in educable retarded children. In R. V. Kail, Jr., & J. W. Hagen (Eds.), Perspectives on the development of memory and cognition. Hillsdale, N.J.: Erlbaum, 1977.

Cattell, R. B. Abilities: Their structure, growth, and action. Boston: Houghton-Mifflin, 1971.

Chiba, A. Developmental structure of intelligence. Tokyo: International Society for Intelligence Education, 1978.

Cronbach, L. J., & Snow, R. E. Aptitudes and instructional methods. New York: Irvington, 1977.

Crowder, R. G. Principles of learning and memory. Hillsdale, N.J.: Erlbaum, 1976.

Ellis, N. R. The stimulus trace and behavioral inadequacy. In N. R. Ellis (Ed.), Handbook of mental deficiency. New York: McGraw-Hill, 1963.

Ellis, N. R. Memory processes in retardates and normals. In N. R. Ellis (Ed.), International review of research in mental retardation (Vol. 4). New York: Academic Press, 1970.

Ellis, N. R., & Hope, R. Memory processes and the serial position curve. Journal of Experimental Psychology, 1968, 77, 613-619.

Farb, J., Cottrell, A. W., Montague, J. C., & Throne, J. M. Update on research into increasing intelligence levels of mentally retarded children. In P. Mittler (Ed.), Research to practice in mental retardation, Vol. II: Education and training. Baltimore: University Park Press, 1977.

Feuerstein, R. The dynamic assessment of retarded performers: The learning potential device, theory, instruments, and techniques. Baltimore: University

Park Press, 1979.

Feuerstein, R. Instrumental enrichment: Redevelopment of cognitive functions of retarded performers. Baltimore: University Park Press, in press.

Fisher, M. A., & Zeaman, D. Growth and decline of retardate intelligence. In N. R. Ellis (Ed.), International review of research in mental retardation (Vol. 4). New York: Academic Press, 1970.

Fisher, M. A., & Zeaman, D. An attention-retention theory of retardate discrimination learning. In N. R. Ellis (Ed.), International review of research in mental retardation (Vol. 6). New York: Academic Press, 1973.

Glanzer, M., & Cunitz, A. R. Two storage mechanisms in free recall. Journal of Verbal Learning and Verbal Behavior, 1966, 5, 351-360.

Goetz, E. M., & Baer, D. M. Social control of form diversity and the emergence of new forms in children's blockbuilding. Journal of Applied Behavior Analysis, 1973, 6, 105-113.

Horn, J. L. Organization of abilities and the development of intelligence. Psychological Review, 1968, 75, 242-259.

Horn, J. L. Theory of functions represented among auditory and visual test performances In J. R. Royce (Ed.), Multivariate analysis and psychological theory. New York: Academic Press, 1974.

House, B. J., & Zeaman, D. Miniature experiments in retardate discrimination learning. In L. P. Lipsitt & C. C. Spiker (Eds.), Advances in child development and behavior (Vol. 1). New York: Academic Press, 1963.

Kahn, J. V. On training generalized thinking. Paper presented at the 85th Annual Convention of the American Psychological Association, San Francisco, August, 1977.

Kane, W. T., & O'Brien, J. J. History of education. Chicago: Loyola University Press, 1954.

Luria, A. R. Study of the abnormal child. American Journal of Orthopsychiatry, 1961, 31, 1-16.

Mann, L. On the trail of process. New York: Grune & Stratton, 1979.

Meichenbaum, D. Cognitive-behavioral modification: An integrative approach. New York: Plenum, 1977.

Mittler, P. (Ed.). Research to practice in mental retardation (Vol. 2): Education and training. Baltimore: University Park Press, 1977.

Newell, A., & Simon, H. A. Human problem solving. Englewood Cliffs, N.J.: Prentice-Hall, 1972.

Shif, Z. I. Development of children in schools for the mentally retarded. In M. Cole & I. Maltzman (Eds.), A handbook of contemporary Soviet psychology. New York: Basic Books, 1969.

Skinner, B. F. The technology of teaching. New York: Appleton-Century-Crofts, 1968.

Spearman, C. The nature of 'intelligence' and the principles of cognition. London: Macmillan, 1923.

Sternberg, R. J. Intelligence, information processing, and analogical reasoning: The componential analysis of human abilities. Hillsdale, N.J.: Erlbaum, 1977.

Sternberg, R. J. Components of human intelligence. (NR 150-412 ONR Technical Report No. 19.) New Haven: Department of Psychology, Yale University, 1979. (a)

Sternberg, R. J. A review of "Six authors in search of a character:" A play about intelligence tests in the year 2000. In R. J. Sternberg & D. K. Detterman (Eds.), Human intelligence: Perspectives on its theory and measurement. Norwood, N.J.: Ablex, 1979. (b)

Sternberg, R. J., & Weil, E. M. An aptitude-strategy interaction in linear syllogistic reasoning. Journal of Educational Psychology, in press.

Stokes, T. F., & Baer, D. M. An implicit technology of generalization. Journal of Applied Behavior Analysis, 1977, 10, 349-367.

Throne, J. M. A radical behaviorist approach to diagnosis in mental retardation. Mental Retardation, 1970, 8.

Turnure, J. E., & Zigler, E. Outer-directedness in the problem-solving of normal and retarded children. Journal of Abnormal and Social Psychology, 1964, 69, 427-436.

Vygotsky, L. S. Mind in society: The development of higher psychological processes. Cambridge, Mass.: Harvard University Press, 1978.

Wanschura, P. B., & Borkowski, J. G. Long-term transfer of a mediational strategy by moderately retarded children. American Journal of Mental Deficiency, 1975, 80, 323-333.

Whimbey, A. (with Whimbey, L. S.) Intelligence can be taught. Stamford, Connecticut: Innovative Sciences, 1978.

Whimbey, A., & Lochhead, J. Problem solving and comprehension: A short course in analytic reasoning. Philadelphia: Franklin Institute Press, 1979.

Whitely, S. E., & Barnes, G. M. The implications of processing event sequences for theories of analogical reasoning. Memory and Cognition, 1979, 7, 323-331.

Wickelgren, W. How to solve problems. San Francisco: W. H. Freeman & Co., 1974.

Zeaman, D. Some relations of general intelligence and selective attention. Intelligence, 1978, 2, 55-73.

Zeaman, D., & House, B. J. The role of attention in retardate discrimination learning. In N. R. Ellis (Ed.), Handbook of mental deficiency. New York: McGraw-Hill, 1963.

Zigler, E. Mental retardation: Current issues and approaches. In M. L. Hoffman & L. W. Hoffman (Eds.), Review of child development research (Vol. II). New York: Russell Sage Foundation, 1967. (a)

Zigler, E. Familial mental retardation: A continuing dilemma. Science, 1967, 155, 292-298. (b)

Zigler, E. Mental retardation. Science, 1967, 157, 578-579. (c)

Zigler, E. Mental retardation. In P. London & D. Rosenhan (Eds.), Foundations of abnormal psychology. New York: Holt, Rinehart, & Winston, 1968. (a)

Zigler, E. Mental retardation. In International encyclopedia of the social sciences (Vol. X). New York: Macmillan, 1968. (b)

Zigler, E. Developmental versus difference theories of mental retardation and the problem of motivation. American Journal of Mental Deficiency, 1969, 73, 536-556.

Zigler, E. The retarded child as a whole person. In H. E. Adams & W. K. Boardman, III (Eds.), Advances in experimental clinical psychology (Vol. 1). New York: Pergamon Press, 1971.

Zigler, E., & Balla, D. Personality development in retarded individuals. In N. R. Ellis (Ed.), Handbook of mental deficiency (2nd ed.). Hillsdale, N.J.: Erlbaum, 1979.

Footnote

[1]Although we disagree with Zeaman's emphasis upon structural variables in the search for the locus of mental retardation, we heartily endorse his sophisticated model-based approach, which seeks to understand differences between the normal and retarded in part through differences in the estimated values of parameters of rigorously specified information-processing theories. We also believe that his focus upon allocation of attentional resources is a productive one for isolating one important locus of difference between normal and retarded performance.

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